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Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,445,368**, on October 17, 2003, by **MICHAEL SUMMERLIN**, for "A Display Unit for Displaying Lenticular Images".

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ABSTRACT

A display unit for displaying lenticular images comprised of a pre- registered lens, a pre- registered image a pre- registered back plate and a mechanical means of stressing the components so that they maintain intimate contact under a releasable pressure to enable the "sandwich" to be opened and the image and lens replaced and still maintain registration.

FIELD OF INVENTION

The invention relates to a means and apparatus to pre-register lenticular images locating them in a compression unit and holding them together in registration without bonding the lens to the image.

BACKGROUND OF THE INVENTION

Lenticular imagery has been available for many years and involves the alignment of a composite image to an optical screen which when viewed from different angles can depict movement of depth. Normally the composite image is bonded or laminated to the lenticular screen in the production house and aligned by eye. This can be a very tedious task and if an error is made both the image and lenticular material are normally wasted. The cost of the lenticular screen, the lamination, the labour required to align the image, the packing and transportation (handling) of a flat object make the end product expensive and unwieldy and has resulted in slow grown in the 3D display industry. This invention incorporates a method of automatically aligning the image by register and sandwich system for compressing the image and lenticular so that the lenticular material, the lamination, the labour and handling are all either reduced or eliminated. The lenticular material stays in the display unit and only the image is substituted. The registration system and the compression system combined make the task of changing images compatible with the unskilled labour commonly used for this task resulting in a simple display system which will accept both 2D and 3D images and enabling either to be displayed at approximately the same cost.

Several designs exist which have been directed towards solving the aforesaid problems. Examples of such designs include:

- US Patent No. 5,391,254, issued on February 21, 1995 to Morton for "Alignment Apparatus And Associated Methods For Depth Images";
- US Patent No. 5,492,578, issued on February 20, 1996 to Morton for "Alignment Apparatus And Associated Methods For Depth Images";
- US Patent No. 5,757,545, issued on May 26, 1998 to Wu et al. for "Lenticular And Barrier Strip Pictures With Changeable Scenes";

- US Patent No. 4,683,871, issued on May 12, 1987 to Young for "Variable Aspect Display";
- US patent no. 4,766,684, issued on August 30, 1988 to Wah Lo "Lenticular Screen For Outdoor Display";
- US Patent No. 5,822,038, issued on October 13, 1998 to Slater et al. for "Apparatus For Stretching And Aligning Film Sheets";
- US Patent No. 5,823,344, issued on October 20, 1998 to Fantone et al. for "Display Systems With Multiple View Optics";
- US Patent No. 5,850,913, issued on December 22, 1998 to Fantone et al. for "Compliant Image Carrying Printed Insert";
- US Patent No. 6,151,062, issued on November 21, 2000 to Inoguchi et al. for "Stereoscopic Image Display Apparatus Using Specific Mask Pattern"; and
- US Patent No 6,226,906, issued on May 8, 2001 to Bar-Yona for "Display Unit".

The above-mentioned designs, however, suffer from a number of important disadvantages. Many of the designs are of a complex nature and require specialized equipment to align an image sheet, sometimes by stretching the image sheet, over a lenticular sheet. The specialized equipment may be impractical for use, when quick replacement and alignment of the image sheet is required. Disadvantageously, the image sheet in most of the examples appears to be sandwiched or supported between the lenticular sheet and a housing backing, with no means of adjusting the image sheet with respect to the lenticular sheet. In the more permanent sandwich arrangements, it may be difficult to replace the image sheet, if required, without destroying the sandwich. Also, in one example, image cards appear to be uses in a rigid case. The image cards appear to be multi-paneled which when a rigid support case is closed appears to cause the image sheet to flatten and position the image sheet adjacent a lenticular sheet. The multi-paneled image cards are pre-folded before positioning in the box, which may be expensive and impractical if multiple image sheet changes are required.

Thus there is a need for an improved image display unit.

SUMMARY OF THE INVENTION

The invention provides a means of displaying both reflective and backlit composite images without adhering them to the lenticular material and having an easy way of changing the images without having to align or adjust them on site. To achieve this we have devised a registration method, which guarantees the integrity of all parts of the display unit so that any part can be interchanged and still maintain the alignment providing the pitch of the lens and the image match.

The lenticular material is laid on a flat vacuum light table which has pre-positioned drills mounted at one end and has a surface printed with parallel lines. The lens is positioned under the drills and located with a pin which registers into one of the lenticular groves securing the lens and acting as a pivot. This enables the lens to be turned until the parallel lines can be seen clearly. The vacuum is applied and the drills actuated to provide accurate perforations always at the same location point relative to the lenticules.

One sheet of aligned lens in kept as a master and fixed to a hinged plate at the head the light table. The images are aligned to this master lens, the vacuum light table swings into the vertical position where the image can be viewed vertically through the lens, both image and lens being held by vacuum. Minor adjustments can be made in this position, the table returned to the horizontal position and the image perforated in the same manner as the lens.

A backing plate is also perforated at the same registration points.

To display the image, the lens, the image and the backing plate are stressed by mechanical means to form a slight radius. The differences in radii force the three components together into intimate contact. The image can be changed by releasing the pressure and separating the components.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a Vacuum Light Table shown in both the vertical and horizontal position and from the back.
Figure 2 is an enlarged view of the mounting clamp assembly
Figure 3 is a view of the table with a lined image and a master lens mounted on the registration table.
Figure 4 shows an image aligned behind the master lens
Figure 5 shows a jig used to make fixing holes in the lens, image and back plate.
Figure 6 is an exploded view of a compression display unit using a stress plate to cause the curve in the lens, image and back plate.
Figure 7 is an exploded view of a compression display unit using tapered dowel pins and stress lings to cause the curve in the lens, image and back plate.

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Figure 8 illustrates the display unit with a stress plate replacing the stress links in Figure 7

Figure 9 illustrates the display unit using an angle and rod as stressing mechanism

Figure 10,11 & 12, illustrates methods of mounting compression display units

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Detailed Description of the Preferred Embodiments

Referring to fig 1 a first embodiment of a Registration Light Table with Pivoting Mechanism shown in the horizontal position (50) and the raised position from back (51) and front (52). Broadly speaking the table consists of a light defusing vacuum table with interior channels (not shown) feeding suction to perforations on the surface (32) to hold down material placed on said surface. The framework (30) is of tubular steel. The vacuum table top (33) of light defusing plastic material. The table top is raised by means of a lever system driven by a motor (34). An adjustable clamping system (35) with drilling and perforating guides is mounted at the head of the table.

Referring now to fig 2 the adjustable clamping system consists of an hinged clamp (26) with perforating and drilling guides (24) placed at predetermined intervals, a spring loaded lenticule locating pin (25), two removable lens locating pins (27) and a pinned (29) and slotted (30) mounting plate (28) which carries an adjustment mechanism allowing for rotational and latteral movement. Movement is controlled by a micro adjustment system (21 & 22).

Referring now to fig 3. A lined image (40) is placed on the vacuum table and held in position with the lines at right angles to hinged clamp (26). A master lens sheet (41) is placed under the hinged clamp (26) and located by depressing the lenticule locating pin (25). The locating pine (25) acts as a pivot and the lens can be turned in either direction to obtain alignment with the lined image (40). An adjustment on the lateral plane is made with the micro adjustment wheel (22). When the alignment is achieved the master lens (41) is drilled through the perforating/drilling guides (24). The lens is now registered with the axis of the drilled holes being at right angles to the lenticules. Two other drilling guides are provided (27) (pins removed) to locate a master lens for the image alignment Fig 4. The procedure is repeated as necessary with other required lens Fig 6 (1). It is also repeated with the registered back plate fig 6 (3) and the stress plate fig 6 (4)

Referring to Fig 4 the pre-aligned and perforated master lens (41) is attached to the clamping mechanism by lens locating pins (27). A pre - trimmed image Fig 6 (2) is placed under the lens and located under the clamp (26) . The vacuum is turned on to hold the image in place. The master lens (41) is aligned with the image by adjusting the two micro adjustment wheels (21 & 22). When alignment is achieved the table is raised to the vertical position Fig 1 (52) for inspection and final adjustments can be made. The table is then lowered and the registration holes punched through the perforating /drilling guides (24). The image (2) is removed and the procedure repeated for other required images.

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Fig 5 is a jig with a top plate (62) and a bottom plate (60). The top plate (62) has drilling guides (61) at one end and receptor holes (62) at the other drilled at matching positions to the perforations in the registered lens fig 6 (1) the registered images Fig 6 (2) the registered back plate fig 6 (3) and the registered stress plate fig 6 (4). Fig 5 (60) has matching location pins (63) at one end and drilling guides (61) at the other. The lens (1) the image (2) the back plate (3) and the stress plate (4) are all located on the pins (63) between the two plates (60) and (62), compressed and drilled through drilling guides (61) so that all components are precisely registered.

Fig 6 is a precisely built standardised display unit (9) for displaying pre-registered lenticular images where the image and lens are precisely registered, held in intimate contact and maintained in that position by mechanical means only, so as to accommodate interchangeability of all pre registered lens and images of matching pitch without adjustments. The precision of this unit is such that if it is subject to temperature changes all the elements must be made of the same material. The display unit consists of (1) a registered lens, (2) a registered image, (3) a registered back plate, (4) a registered compliant stress plate and (13) a stress bar. The lens (1) the image (2) the back plate (3) are located on drilled dowel pins (15). The stress bar (13) is fixed between the back plate (3) and the stress plate (4). A threaded rod (11) passes through the dowel pin (15) and is fixed with nuts (12) and (8) so that when the rear nut (8) is tightened the stress plate (4) is forced inwards causing the lens(1) the image (2) and the back plate (3) to bend so that the difference in radii of lens and image forces the two elements together into intimate contact. A locking nut (10) is placed between the back plate (3) and the stress plate (4) to hold the threaded rod in place in such a manner that when the front nut (12) is released the pressure is released and the sandwich can be taken apart without loosing the threaded rod (11). The lens (1) and image (2) can be removed and changed from the front of the unit.

Fig 7 is a precisely built standardised display unit (15) for displaying pre-registered lenticular images where the image and lens are precisely registered, held in intimate contact and maintained in that position by mechanical means only, so as to accommodate interchangeability of all pre-registered lens and images of matching pitch without adjustments. The precision of this unit is such that if it is subject to temperature changes all elements must be made of the same material. The display unit consists of a registered lens (1) a registered image (2) a registered back plate (3) a stress link(13) with larger registered perforations set at a lesser distance apart than the mating back plate fig 8. Tapered threaded dowel pins (5) pass through the registered perforations in the lens (1), the image (2), the back plate (3) and the stress link (13), The lock nut (6) holds the "sandwich"(1) (2) (3) together, the stress links(13) ride up the taper by pressure from the wing nut (8) through the spacer (7) effectively shortening their length causing the lens and image to curve so that the difference in radii of lens and image force the two elements together into intimate contact. The image is changed by removing the wing nut (8), the spacer (7) the stress link (13) the lock nut (6) and the back plate.

Fig 8 illustrates the display unit fig 7 (15) with a stress plate (16) replacing the stress links.

Fig 9 illustrates a display unit similar to fig. 7 (15) where the curve is created by an angle (14) affixed to the top and bottom of the sandwich made from the lens(1) image (2) and back plate (3) and a threaded rod(17) used as a stress link.

Fig 10 illustrates a standardised display unit as in fig 6 (9) and fig 7 (15) fig (8) and fig (9) with hanging eyes (18) to suspend the unit by wire or other means from above.

Fig 11 illustrates a standardised display unit as in fig 6 (9) and fig 7 (15) fig (8) and fig (9) with brackets (19) for installation into a backlit display box.

Fig 12 illustrates a standardised display unit as in fig 6 (9) and fig 7 (10) fig (8) and fig(9)mounted in a slotted base (20) with cable attachments (19) as supports.

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Patent Claims

1 A precisely built standardised display unit for displaying pre-registered lenticular images where the image is viewed through the lens and in which the image and lens are precisely registered, held in intimate contact and maintained in that position by mechanical means only, so as to accommodate interchangeability of all pre-registered lens and images of matching pitch on site with no adjustment.

2 A display unit as in claim 1 in which the lens, image and backplate are clamped together and bent on one plane so that the difference in the radii of lens, image and backplate force the elements together.

3 A display unit as in claim 1 in which the lens and image are stretched over a curved back plate to force the image and lens together

4 A display unit as in claim 1 in which one or more dowel pins register the lens and image relative to each other.

5 A display unit according to claim 2 in which the lenticular lens, image and backplate are clamped together by tapered dowel pins.

6 A display unit according to claim 2 in which the lenticular lens image and backplate are clamped together by drilled dowel pins.

7 A display unit according to claim 2 in which the lenticular lens, image and backplate are clamped together by dowel pins and screws or other means.

8 A display unit according to claim 2 in which the two elements are forced together by a back plate or other means

9 A display unit as in claim 2 where the elements are forced together by a stress link.

10 An apparatus according to prior claims in which the co-efficient of expansion of the elements eliminate the effect of temperature changes.

11 Apparatus according to prior claims which can be retrofitted into an existing backlit display box.

12 Apparatus according to prior claims which can be independently suspended.

13 Apparatus according to prior claims which can be mounted in a base and be free standing.

14 Apparatus for permanently and precisely registering and aligning the lenticular lens and other display unit components by dowel holes positioned on an axis at right angles to the lens lenticules.

15 Apparatus for punching matching dowel holes in images at the appropriate position relative to the pre-perforated lens and other display unit components.

16 Apparatus as in claims 10 & 11 consisting of a pivoting vacuum light table with precise and standardized drilling and perforating stations and which secures an image by vacuum and a lenticular or plastic sheet by mechanical means with vacuum assist so that said lenticular sheet and plastic components can be adjusted to align with the image or with parallel lines placed in a fixed position.

17 An assembly jig which holds image, lens, back plate and stress plate by registration holes providing accurate means of drilling secondary registration holes to accommodate additional dowel pins or other means to hold the sandwich together in intimate contact.

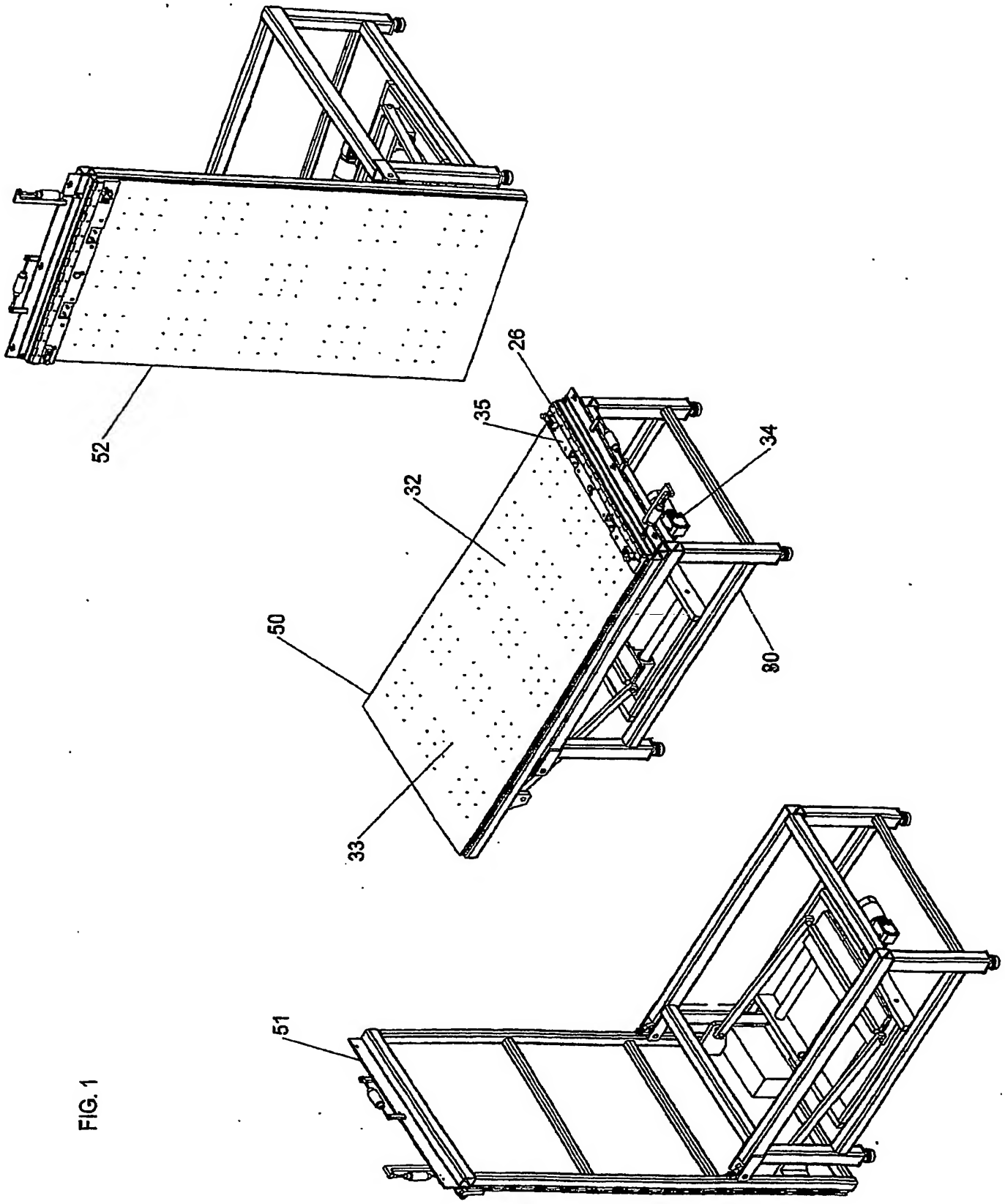


FIG. 1

FIG. 2

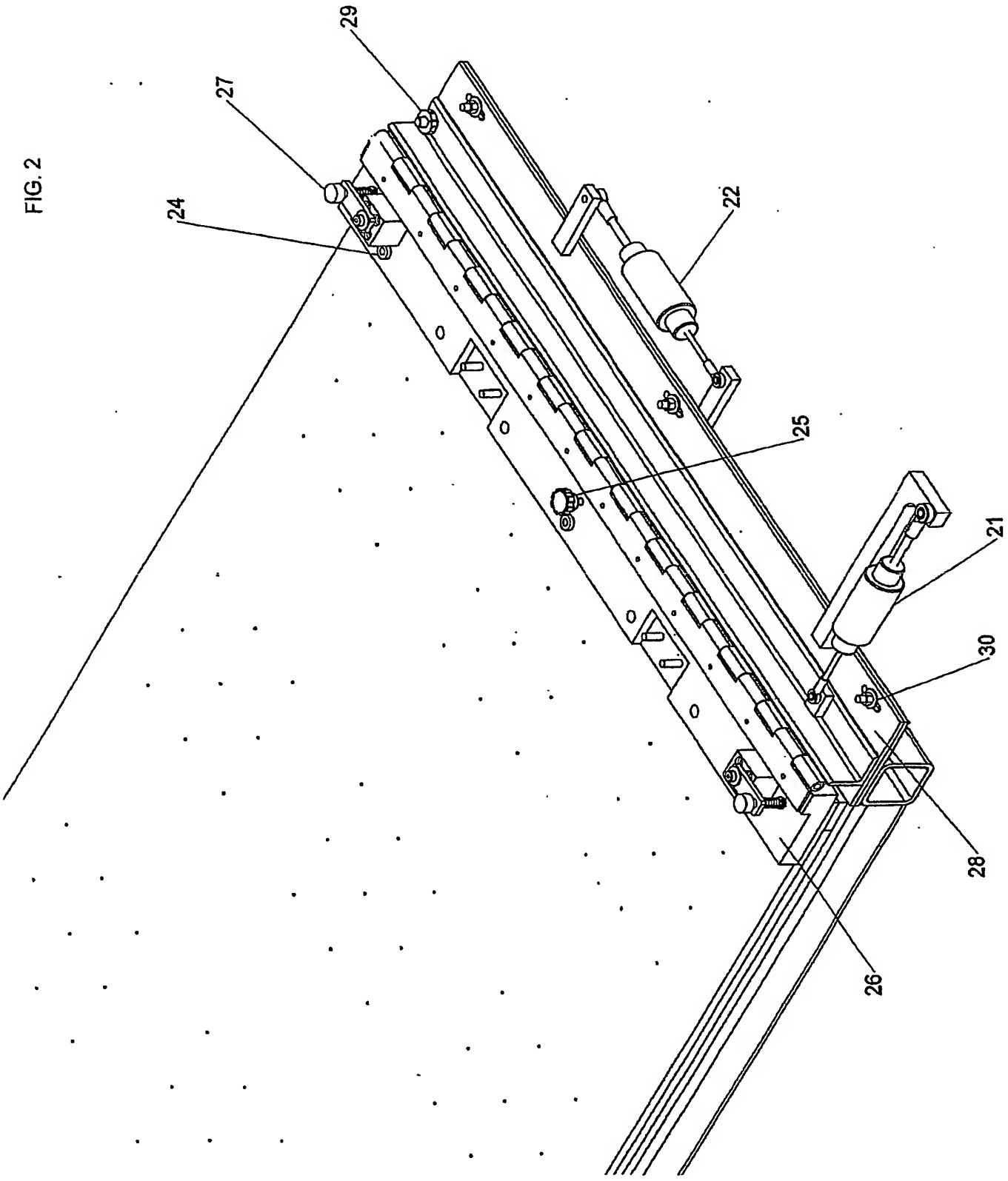


FIG. 3

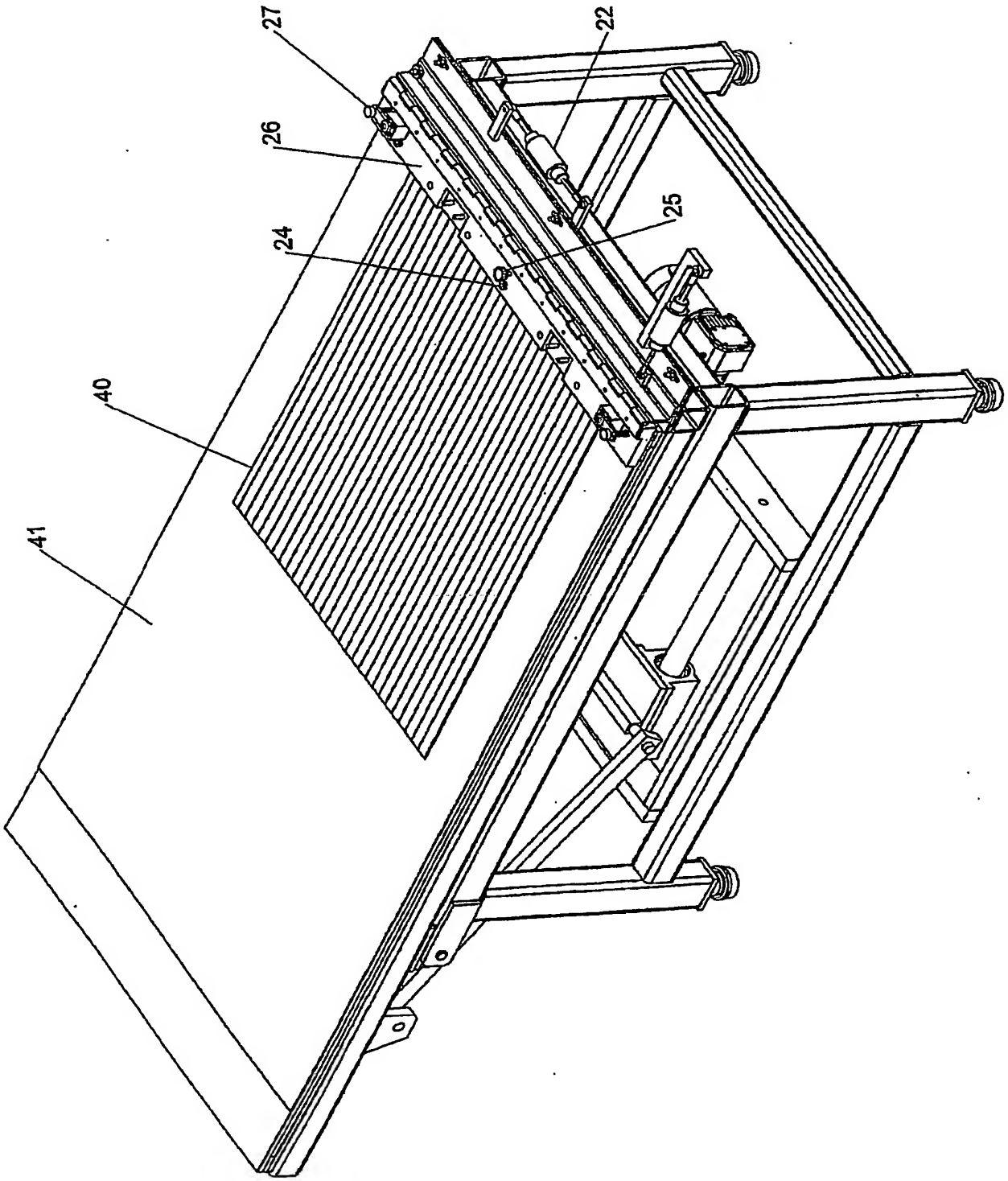


FIG. 4

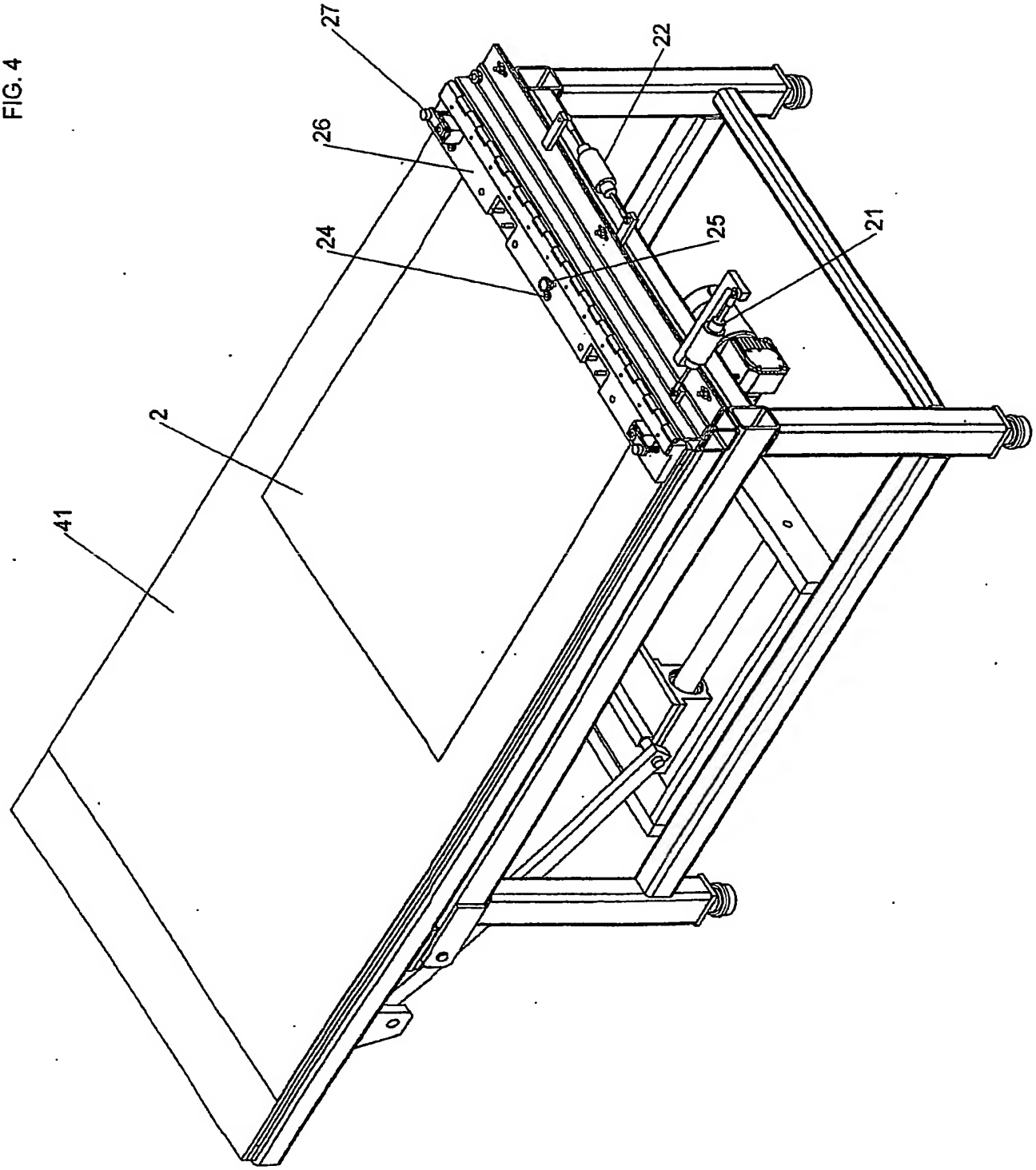


FIG. 5

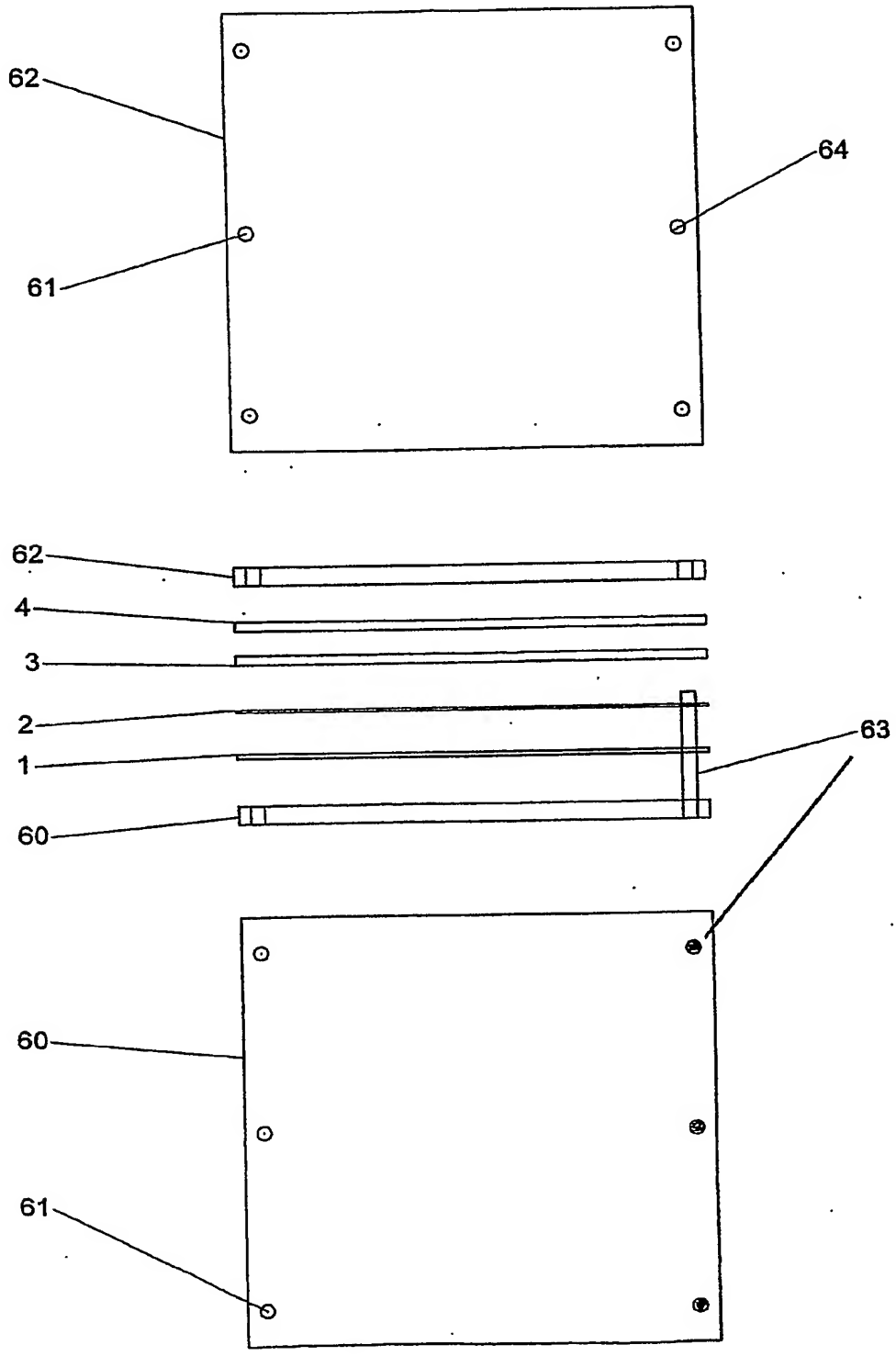


FIG. 6

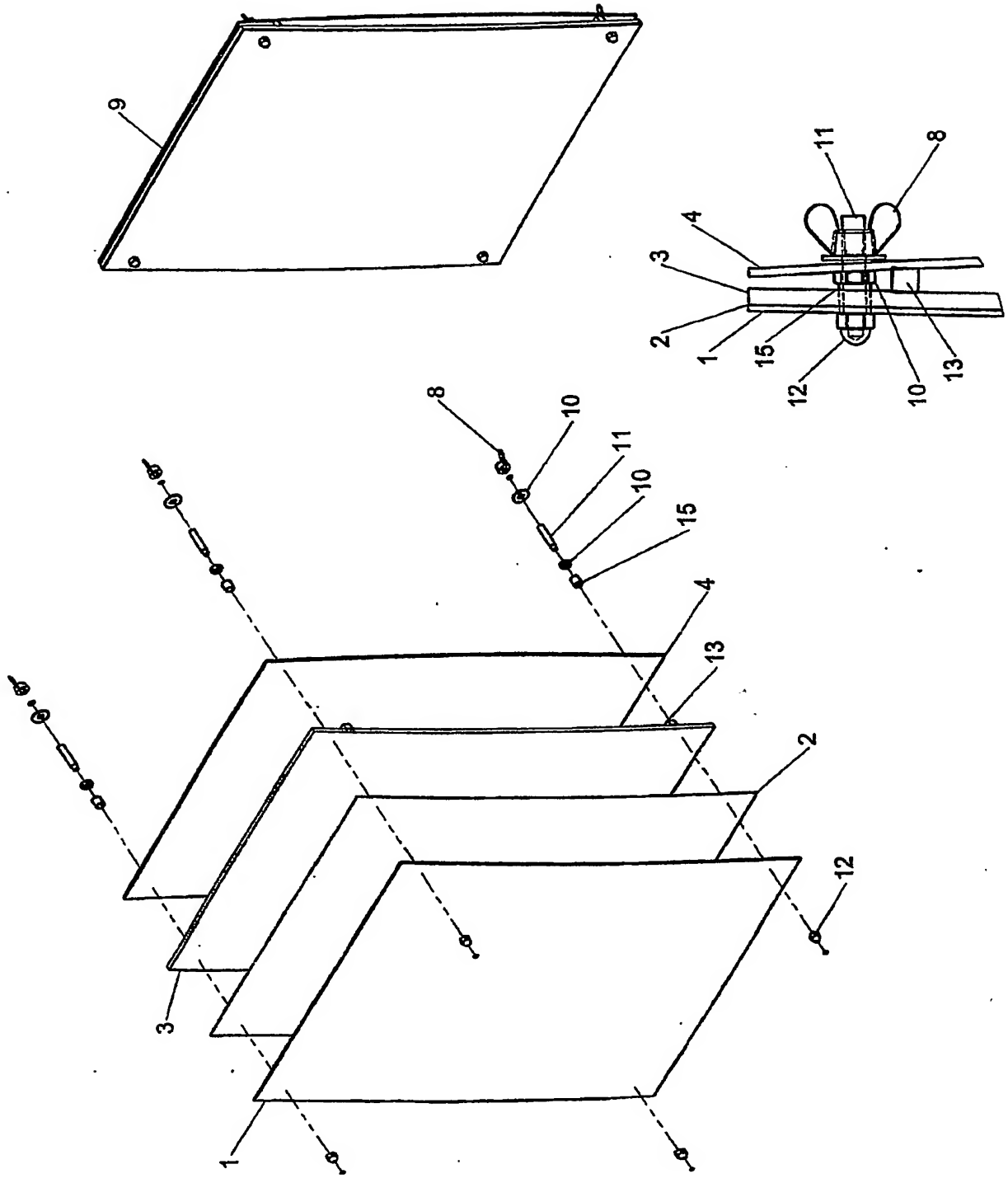


FIG. 7

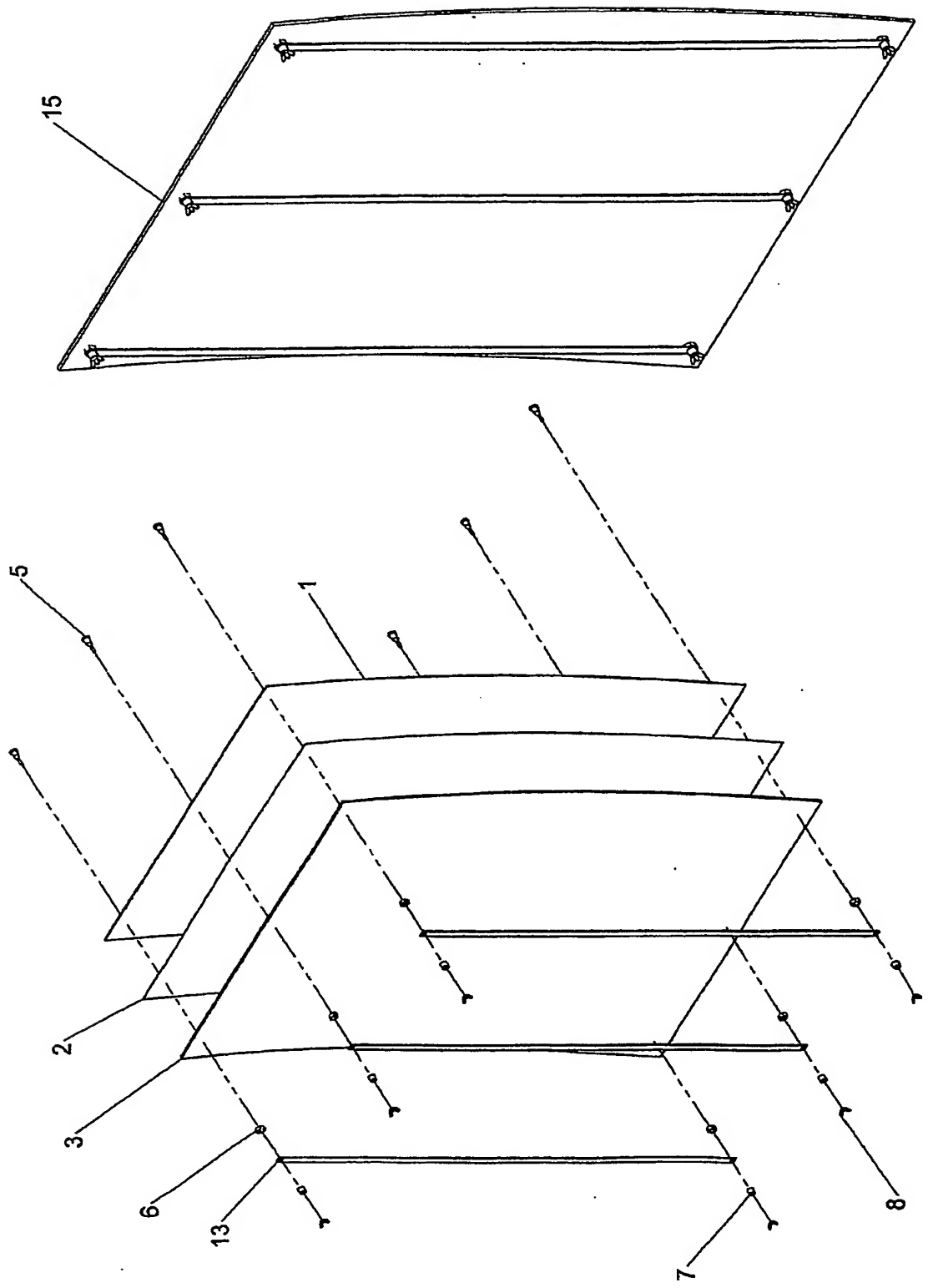


FIG. 8

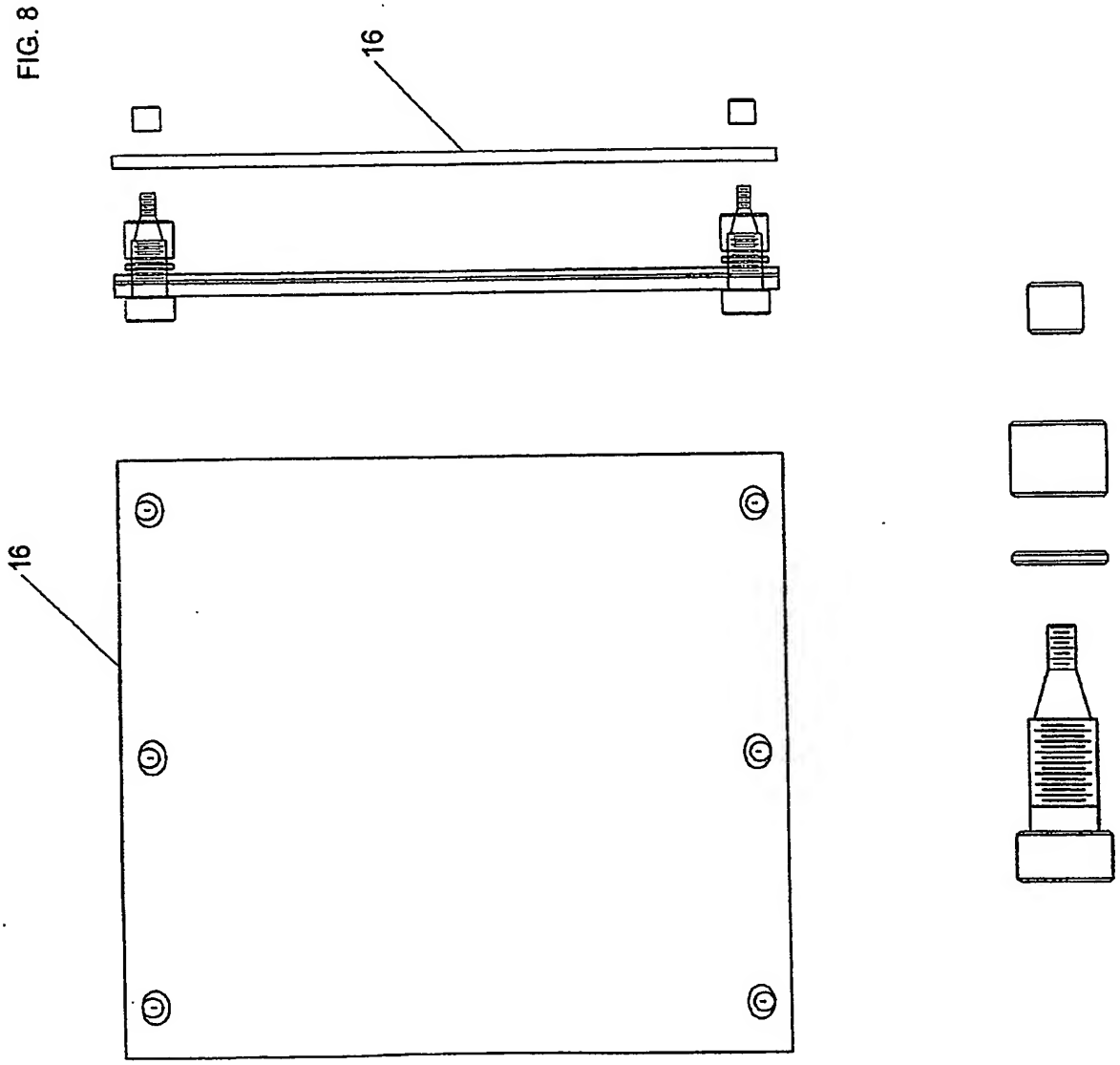
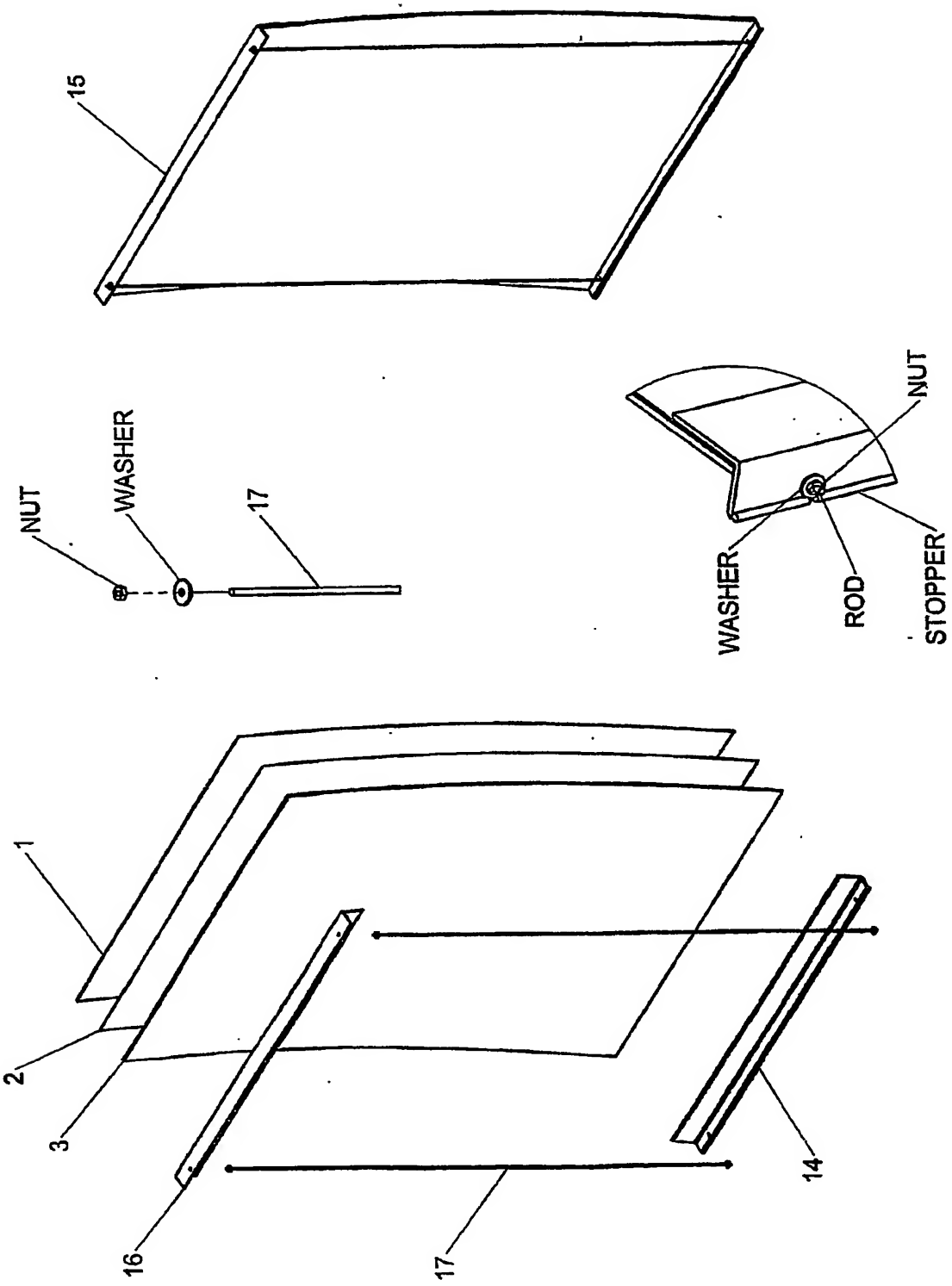


FIG. 9



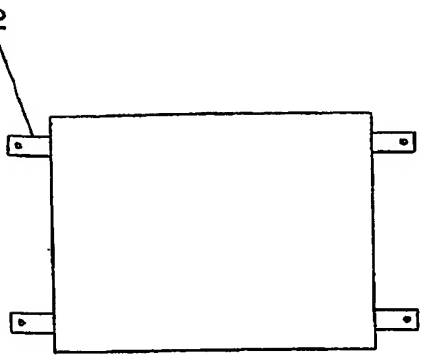


FIG. 11

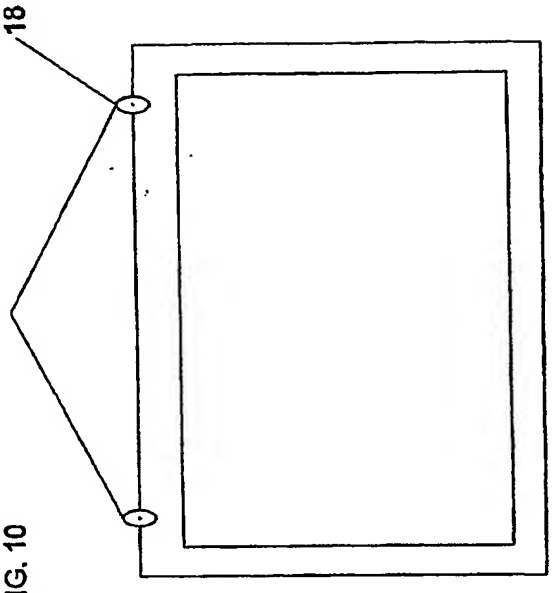


FIG. 10

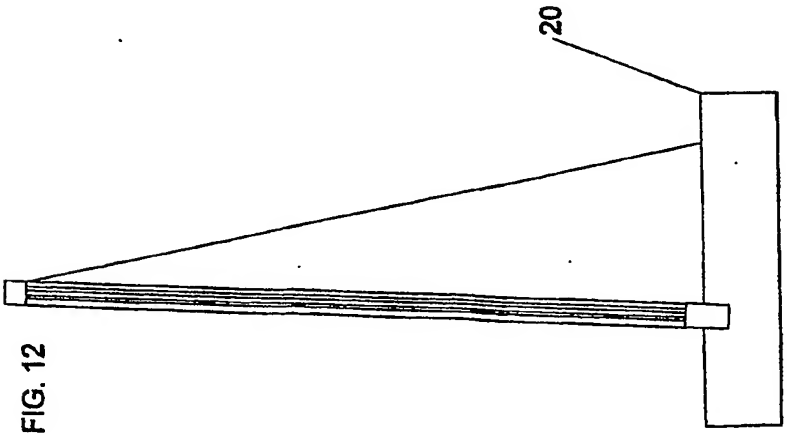


FIG. 12